

WHAT IS CLAIMED IS:

1. An ink-jet apparatus employing an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps and performing printing by ejecting an ink from the ink-jet head toward a printing medium, comprising:

printing means for performing printing operation in a predetermined ink ejection amount among the plurality of steps of ink ejection amounts in said ink-jet head; and

preliminary ejection means for performing ink ejection not associated with printing, from said ink-jet head, at an ejection amount greater than said predetermined ink ejection amount among the plurality of steps of ink ejection amounts.

2. An ink-jet apparatus employing an ink-jet head having a plurality of energy generating elements corresponding to one ejection opening and performing printing by ejecting an ink to a printing medium utilizing the energy generated by the energy generating elements, comprising:

printing means for performing printing operation in a plurality of ink ejection amount modes established by combination of an energy generating

element to be used among the plurality of energy generating elements; and

preliminary ejection means for performing ink ejection not associated with printing, from said ink-jet head used for printing operation, while said printing operation is performed in one of said plurality of ejection amount modes, the ink ejection by said preliminary means being performed in the ejection amount mode having ejection amount greater than or equal to the ejection amount of the ejection amount mode employed in said printing operation.

3. An ink-jet apparatus as claimed in claim 2, wherein the plurality of energy generating elements are mutually differentiated the magnitude of the energy to be generated.

4. An ink-jet apparatus as claimed in claim 2, wherein the plurality of energy generating elements generates equal magnitude of energy to each other and said printing means differentiates the ejection amount modes by varying number of energy generating elements to be used.

5. An ink-jet apparatus as claimed in claim 4, wherein, in printing operation of the ejection amount

mode, in which not all of the plurality of energy  
generating elements are used, said preliminary  
ejection means performs ink ejection with employing  
one greater number of energy generating elements than  
5 that employed in said printing operation.

6. An ink-jet apparatus employing an ink-jet head  
having a plurality of energy generating elements  
corresponding to one ejection opening and performing  
10 printing by ejecting an ink to a printing medium  
utilizing the energy generated by the energy  
generating elements, comprising:

printing means for performing printing operation  
in a plurality of ink ejection amount modes  
15 established by combination of an energy generating  
element to be used among the plurality of energy  
generating elements; and

preliminary ejection executing means having  
preliminary ejection modes respectively corresponding  
20 to the plurality of ejection amount modes.

7. An ink-jet apparatus as claimed in claim 6,  
wherein said preliminary ejection executing means  
further has a preliminary ejection mode upon switching  
25 of the ejection amount modes.

8. An ink-jet apparatus as claimed in claim 2,  
wherein the energy generating element generates a  
thermal energy to generate bubble in the ink for  
ejecting the ink by generation of the bubble.

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9. An ink-jet apparatus employing an ink-jet head  
having a plurality of heaters corresponding to one  
ejection opening and performing printing by ejecting  
an ink from said ink-jet head to a printing medium,

10 comprising:

driving means for applying respective pulses to  
the plurality of heaters for bubbling the ink for  
ejecting the ink through said one ejection opening,  
said driving means being capable of mutually shifting  
15 timings of bubbling at respective of said plurality of  
heaters on a basis of information relating to an ink  
temperature of said ink-jet head.

10. An ink-jet apparatus as claimed in claim 9,  
20 wherein the plurality of heaters are heaters identical  
in position relative to one ejection opening, size and  
heating characteristics with respect to each other.

11. An ink-jet apparatus as claimed in claim 9,  
25 wherein the plurality of heaters are heaters different

in position relative to one ejection opening, size and heating characteristics with respect to each other.

12. An ejection amount controlling method in an ink-jet apparatus employing an ink ejecting portion having a plurality of heaters corresponding to one ejection opening and ejecting ink from said ink ejecting portion to a printing medium, said method comprising the step of:

10        adjusting an ink ejection amount by mutually shifting bubbling timing at respective of the plurality of heaters upon application of respective pulses to the plurality of heaters for causing bubbling of ink to eject ink through the ink ejection  
15        opening.

13. An ejection amount stabilizing method in an ink-jet apparatus employing an ink ejecting portion having a plurality of heaters corresponding to one ejection  
20        opening and ejecting ink from said ink ejecting portion to a printing medium, said method comprising the step of:

          stabilizing an ink ejection amount by mutually shifting bubbling timing at respective of the  
25        plurality of heaters upon application of respective pulses to the plurality of heaters for causing

bubbling of ink to eject ink through the ink ejection opening so as to adjust the ink ejection amount.

- 5 14. An ink-jet apparatus employing an ink-jet head having a plurality of heaters corresponding to one ejection opening, and ejecting ink from said ink-jet head to a printing medium, comprising:

10 head driving means for applying a preceding pulse which does not cause ejection and a subsequent pulse following said preceding pulse to generate a bubble for ejecting the ink;

15 ejection amount mode setting means for setting an ejection amount mode by selecting heater to be applied the subsequent pulse among said plurality of heaters; and

20 pre-pulse control means for controlling application of the preceding pulse through said head driving means in respective ejection amount modes set by said ejection amount mode setting means, on a basis of information relating to an ink temperature of said ink-jet head.

- 25 15. An ink-jet apparatus employing an ink-jet head arranged first and second heaters corresponding to one ejection openings and ejecting an ink droplet of a

selected one of a plurality of ejection amounts by generating bubble by driving said first and second heaters in combination, comprising:

driving means for driving said first and second  
5 heaters with a pre-heat pulse in advance of driving with a main heating pulse.

16. An ink-jet apparatus as claimed in claim 15,  
wherein said driving means has an ejection amount mode  
10 established by driving said first heater, an ejection amount mode established by driving said second heater, and an ejection amount mode established by driving both of said first and second heaters.

15 17. An ink-jet apparatus as claimed in claim 16, wherein said driving means performs control of the pre-heat pulse at least on a basis of a temperature information of the ink-jet head and/or temperature calculated value of the ink-jet head.

20 18. An ink-jet apparatus as claimed in claim 16, wherein said driving means varies setting of the heaters driven by the pre-heat pulse and/or pre-heat control mode depending upon the ejection amount mode.

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19. An ink-jet apparatus as claimed in claim 18,  
wherein said driving means performs at least pre-  
heating by the heater driving for main heating.

5 20. An ink-jet apparatus as claimed in claim 18,  
wherein said driving means performs pre-heating with  
the heater other than the heater driven for main  
heating.

10 21. An ink-jet apparatus as claimed in claim 17,  
wherein the control of the pre-heat pulse by said  
driving means is to vary a pulse width of the pre-  
heat-pulse.

15 22. An ink-jet apparatus as claimed in claim 17,  
wherein the control of the pre-heat pulse by said  
driving means is to vary a period between said the  
pre-heat pulse and the main heat pulse.

20 23. An ink-jet apparatus as claimed in claim 17,  
wherein said driving means varies a control mode of  
pre-heating depending upon the ejection amount mode.

24. An ink-jet apparatus as claimed in claim 23,  
25 wherein said driving means switches the heater to be



driven by the pre-heat pulse depending upon the head temperature information of the ink jet head.

25. An ink-jet apparatus as claimed in claim 17,  
5 wherein said driving means drives different heaters with the pre-heat pulse and the main heat pulse, respectively.

26. An ink-jet apparatus employing an ink-jet head  
10 arranged a plurality of mutually different heaters corresponding to one ejection opening and ejecting ink droplet of a plurality of mutually different ejection amounts by driving the plurality of heaters in combination to generate a bubble, comprising:

15 a table used for driving the heaters in the combination corresponding to respective combinations of said plurality of heaters.

27. An ink-jet apparatus as claimed in claim 26,  
20 wherein said table includes a table used for driving two or more of said plurality of heaters.

28. An ink-jet apparatus as claimed in claim 27  
wherein said table is switched depending upon the  
25 temperature information of said ink-jet head.

29. An ink-jet apparatus employing an ink-jet head arranged a plurality of heaters corresponding to one ejection opening and ejecting an ink from the ink-jet head to a printing medium, comprising:

5        setting means for setting presence or absence in heater driving irrespective of ejection data for respective of the plurality of heaters; and

          ejection data setting means for establishing correspondence between ejection data and the ejection  
10        openings to perform ink ejection on a basis of said ejection data, depending upon combination of presence or absence of driven heaters set by said setting means.

15        30. An ink-jet apparatus as claimed in claim 29, wherein a density of printing is set by setting by said setting means and correspondence established by said ejection data setting means.

20        31. An ink-jet apparatus as claimed in claim 29, wherein ejecting position between a plurality of ink-jet heads is adjusted by setting by said setting means and correspondence established by said ejection data setting means.

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32. An ink-jet apparatus as claimed in claim 29  
wherein an ink amount to be ejected for one pixel is  
set by setting by said setting means and  
correspondence established by said ejection data  
5 setting means.

33. An ink-jet apparatus as claimed in claim 29, which  
further comprises data generating means for generating  
interpolating ejection data on a basis of the ejection  
10 data and wherein said ejection data setting means  
establishes correspondence of the interpolating  
ejection data to the ejection openings other than the  
ejection openings for which correspondence has been  
established.

34. An ink-jet apparatus as claimed in claim 32,  
wherein the ink amount to be ejected for one pixel is  
determined by setting of the ejection amount of  
respective of ejection openings for which the  
20 correspondence have been established by the  
combination of said driven heaters.

35. An ink-jet apparatus as claimed in claim 33, which  
further comprises a feeding amount setting means for  
25 setting relative shifting magnitude between said ink-  
jet head and said printing medium depending upon

combination of presence and absence of driven heater  
set by said setting means, and wherein printing is  
performed for a given range on the printing medium by  
scanning of said ink-jet head for the times determined  
5 by said relative shifting magnitude set by said  
feeding amount setting means.

36. An ink-jet apparatus as claimed in claim 34,  
wherein said ejection timing is varied depending upon  
10 the ejection amount set with respect to the  
corresponded ejection opening.

37. An ink-jet apparatus for performing printing  
employing an ink-jet head having ejection openings  
15 which can sequentially differentiate a size of ink  
droplet among a plurality of sizes per in each  
scanning cycle or per every scanning cycles,  
comprising:

means for driving said ink-jet head with  
20 relatively shifting said ink-jet head relative to said  
printing medium so that a plurality of different sizes  
of ink droplets are ejected so as to form a plurality  
of different sizes of dots which are complementary  
disposed to each other.

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38. An ink-jet apparatus as claimed in claim 37,  
wherein said plurality of sizes of ink droplets are  
formed by combination of a plurality of heaters in  
said ink-jet head.

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39. An ink-jet apparatus as claimed in claim 37,  
wherein combination of said plurality of heaters is  
differentiated depending upon a kind of the printing  
medium to be used.

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40. An ink-jet apparatus for performing printing  
employing an ink-jet head having ejection openings  
which can sequentially differentiate a size of ink  
droplet among a plurality of sizes per in each

15 scanning cycle or per every scanning cycles, wherein  
ejection timing of is differentiated depending  
upon the size of the ink droplet.

41. An ink-jet apparatus having an ink-jet head  
20 capable of ejecting mutually different two sized of  
ink droplets and capable of reciprocal printing,  
comprising:

first mode executing means for performing printing  
with a large ink droplet in one of forward and reverse  
25 printing directions;

second mode executing means for performing printing with a small ink droplet in the other of the forward and reverse printing directions; and

switching means for switching said first and  
5 second modes.

42. An ink-jet apparatus having an ink-jet head capable of ejecting mutually different two sizes of ink droplets, comprising:

10 means for varying ejection timing of the ink droplet depending upon the size of the ink droplet or combination of heaters to be driven.

43. An ink-jet apparatus employing an ink-jet head, in  
15 which a plurality of ejection openings are arranged in a form of array, and performing printing of a density of  $1/N$  with ejection opening group of  $1/N$  ( $N \geq 2$ ) of ejection opening array, comprising:

printing executing means for executing ejection  
20 mode<sup>c</sup> depending upon the density.

44. An ink-jet apparatus employing ink ejecting portion having a plurality of heaters corresponding to one ejection opening and ejecting ink from the ink  
25 ejecting portion to a printing medium, comprising:

driving means for driving the plurality of heaters with varying combination of the heaters to be driven and/or varying driving energy to be applied to the heaters to be driven.

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45. An ink-jet apparatus employing an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps and performing printing by ejecting an ink from the ink-jet head toward a printing medium, comprising:

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preliminary ejection means for performing preliminary ejection operation with a large ejection amount and preliminary ejection operation with a small ejection amount; and

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preliminary ejection interval setting means for setting an interval between preliminary ejection operations with the small ejection amount shorter than an interval between preliminary ejection operations with the large ejection amount.

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46. A method for performing a preliminary ejection not associated with printing from an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps, comprising the steps of:

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performing preliminary ejection operation with a large ejection amount;

performing preliminary ejection operation with a small ejection amount; and

setting an interval between preliminary ejection operations with the small ejection amount shorter than  
5 an interval between preliminary ejection operations with the large ejection amount.